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Speech Profile of Individuals with Dysarthria Following First Ever Stroke

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ABSTRACT

Background: There is a high incidence and prevalence of stroke in India and communication impairments following it is commonly reported such as dysarthria, dysphagia, aphasia, apraxia. Dysarthria is a frequent and persisting sequel of stroke which poses challenges in individual's life; however, it has received limited attention in literature. Moreover, there is sparse data available in Indian context hence the present research was planned. The study aimed at investigating speech characteristics, speech intelligibility and global severity of dysarthria in individuals following stroke. It also investigated various factors that influence the speech intelligibility and global severity of dysarthria. Methods: Forty-eight individuals with dysarthria following first ever stroke with mean age of 61 years participated in the study. Presence of stroke was confirmed by medical professional based on CT and/or MRI along with clinical evaluation. Perceptual assessment of speech was carried out and participants were classified into different dysarthria types based on Mayo clinic system by an SLP followed by assessment of speech intelligibility and global dysarthria severity. Results: Imprecise articulation, slow speaking rate, hoarse voice, monopitch and monoloudness were the common speech characteristics presented by most participants irrespective of dysarthria type. Further, presence of unilateral upper motor neuron dysarthria was frequently observed followed by spastic type. Speech intelligibility and global severity of dysarthria was impaired ranging from mild to severe in individuals with dysarthria. There was an association of some factors with speech intelligibility and/or global severity such as type of lesion, type of dysarthria, postural control, locomotion and activities of daily living. Conclusions: This study presents some speech characteristics common to individuals with dysarthria following stroke irrespective of dysarthria type. It also highlights the factors which contribute majorly to reduced speech intelligibility and/or global severity.

INTRODUCTION

World Health Organization (WHO) clinically defines stroke as the rapid development of clinical signs and symptoms of a focal neurological disturbances lasting more than 24 hours or leading to death with no apparent cause other than vascular origin. Stroke or a cerebral vascular accident, is the sudden death of brain cells due to inadequate blood supply. A review based on Indian studies reported that the incidence rate of stroke is 119-145 per 100,000 population and the estimated adjusted prevalence rate of stroke range between 84-262 per 100,000 in rural and 334-424 per 100,000 in urban Indian population [1,2]. A study reported that approximately 200 million people suffer from stroke each year in India and of these 5 million do not survive [3]. Knowing the high incidence and prevalence of stroke in India, it is necessary to explore and estimate types and extent of communicative disorders following stroke.

Commonly noted sequels of stroke include paralysis/paresis; communication and speech deficits; swallowing and cognitive impairments. Most frequently observed communicative impairment following stroke is dysarthria followed by aphasia, verbal apraxia and cognitive deficits, however incidence of swallowing disorders is very high among individuals following stroke [4-8]. It's a well knows fact that persons with stroke can have permanent communication and swallowing deficits which are usually not resolved by medical mode of treatment.

A frequent and persisting sequel to stroke is Dysarthria which poses a challenge in an individual's social participation, emotional disruption and carries the burden of stigmatization [9]. Duffy [10] described dysarthria as a '.....neuro-motor disorder resulting from abnormalities in speed, strength, steadiness, range, tone or accuracy of movements

required for the control of speech'. It affects multiple systems of speech production like phonation (hoarseness of voice or breathy voice), articulation (imprecise consonants, staccato speech), resonance (hypernasality or hyponasality), prosody (monotonous speech), fluency (slow rate of speech or palilalia) and respiration (shortness of breath). Dysarthria can be classified into eight categories based on Mayo clinic system, namely flaccid (lower motor neuron), spastic (bilateral upper motor neuron), ataxic (cerebellum), hypokinetic (basal ganglia control circuit), hyperkinetic (basal ganglia control circuit), unilateral upper motor neuron (unilateral upper motor neuron), mixed (more than one of the foregoing), undetermined. This classification system was based on pioneer work of Darley, Arenson and Brown [11] and commonly referred as Mayo clinic system. A clinical audit conducted on 1276 case studies carried on individual dysarthria by speech-language pathology revealed that in 22% of case studies evident aetiology was stroke. Further, vascular aetiology was found in 90% of UUMN dysarthria, 29% of spastic, 13% of ataxic, 11% of mixed, 9% of hypokinetic, 4% of flaccid and only 1% of hyperkinetic dysarthrias. These findings point to the fact that stroke is represented in all categories of dysarthria of the Mayo system [10].

Research on dysarthria in stroke has documented anatomic site of lesion, side of lesion, pathoaetiology [12-15], spectrum of associated clinical characteristics [10,13,14,16-19]. Course of dysarthria in stroke has not been investigated longitudinally but a few negative effects on level of outcome have been reported. Some studies have documented change in dysarthria severity over few weeks to six months [20]. Also, individual's experience and perception due to communication impairment [9,21] and effect of behavioural intervention [22-26] has been studied.

Perceptual speech characteristics of dysarthria following stroke at varied anatomic lesion location have been studied. The anatomical lesion studies include dysarthria resulting from unilateral UMN damage [17]; bilateral UMN damage or both unilateral and bilateral UMN damage [18], unilateral or bilateral cerebellar damage with and without brainstem involvement [13], mixed location unilateral damage [14-15] or mixed location right hemisphere damage [16]. Also, a review article on dysarthria in stroke has summarized auditory-perceptual features of dysarthria [20]. The results of these studies indicate that features of dysarthria such as reduced intelligibility, slurring of speech/imprecise articulation, harsh and strained voice, reduced rate, reduced inflection, whether transient or permanent, are commonly seen in patients with stroke irrespective of lesion location.

Assessment of the predictive value of auditory-perceptual analysis for lesion localization is identified as a key area of dysarthria research [10] but there is some evidence that features of dysarthria may not always be representing specific dysarthria types as described in Mayo clinic system and it does not always match with objective lesion location [27]. Irregular articulatory breakdown, a key conventional feature of ataxic type, could not differentiate between cerebellar and extra-cerebellar lesions [14] scanning speech, another typical feature of vascular cerebellar lesion, was not found in isolated as well as combined vascular cerebellar lesions [13,15], and ataxic-like speech characteristics was observed in patients with UUMN lesions [19]. Harsh and breathy voice qualities are not associated with any lesion site [14] and there are similarities in the speech characteristics of participants with differing lesion locations, however, having same aetiology stroke [20]. The above findings are contrary to conventional mayo clinic classification and could not be associated to features classically observed in specific dysarthria types.

A few studies have highlighted the effect of lesion side on dysarthria, its severity, and clinical characteristics. Dysarthria has been observed commonly in left hemispheric lesion compared to right, indicating that descending pathway from the left motor cortex is more dominant [15,14,20] and also severity of dysarthria was higher in left sided lesions compared to right irrespective the site of lesion [14]. Articulatory errors and rate reduction were more prominent in left lesions while dysprosody was more prominent in right lesions [17]. Moreover, a few parameters such as voice, hypernasality and intensity control could not be associated with lesion side [17,14]. It's well known that fact that dysarthria is a first and frequent symptom of stroke yet there is limited information on its range of clinical characteristics, anatomic specificity with respect to lesion location, and lesion side. Despite its high incidence of dysarthria in stroke, this communication disorder has received limited attention in published literature. Hence, the study aimed at exploring speech of individuals with dysarthria following stroke. The objectives were two-fold; firstly, to study speech characteristics, speech intelligibility and global severity of dysarthria in individuals following stroke, and secondly, to find association of speech intelligibility and global severity with various factors.

METHODS

Ethics

The study was carried at and approved by Ethical committee of Audiology and Speech Language Pathology Institute affiliated to a deemed university in the city of Pune, India. An informed consent was obtained from each participant of this study.

Participants

A total of 48 individuals having sudden onset dysarthria due to first ever stroke, whether ischemic or hemorrhagic, confirmed by medical professional based on CT or MRI and neurological examination were selected. The participants were Marathi speaking and their age ranged between 30 to 95 years with average age of 60.47 years. At the time of assessment, participant's onset of stroke ranged from 2 days to 8 years. Participants with altered consciousness, orientation and alertness; having known co-occurring language, cognitive, psychological disorder; having any known premorbid history of speech language, hearing or communication impairments; and/or having dysarthria due to neurodegenerative conditions, neuromuscular diseases, head trauma or neurosurgery were excluded. However, participants with co-occurring dysphagia were included.

Procedure

For each participant, written consent, bedside evaluation and dysarthria assessment was carried out.

Bedside evaluation

Bedside evaluation protocol [28] followed at the study center was administered on each participant. The protocol had five different sections ; (a) A detailed case history which included demographic details, medical history, onset and nature of stroke, MRI/CT scan, and history of hypertension (HTN), diabetes (DM) or any other medical condition; (b) current physical status in terms of locomotion, postural control of limbs, head & neck, trunk and pelvis, gait, activities of daily living, and feeding; (c) oral motor examination including structural and functional assessment of lips, tongue, jaw, and palate, and speech examination of different subsystems including respiratory, phonatory, articulatory, resonanatory and prosodic, (d) language evaluation included mode of communication, comprehension, expression, repetition, and naming; (e) cognitive status assessed by evaluating individuals level of consciousness, alertness, orientation, awareness, directionality, attention, and memory (f) swallowing evaluation checking mode of feeding, respiratory status, duration, nature and frequency of swallowing problem, effect of type and consistency of food, nutrition, oral sensation, oral control, and cough sensitivity. The bedside protocol was used to rule out presence of language and/or cognitive impairments.

Assessment of dysarthria

Presence of dysarthria was confirmed by an experienced SLP on mayo clinic assessment and perceptually rating spontaneous speech of participants. Parameters of speech in its each system like respiration, phonation, articulation, resonance and prosody were assessed. Speech intelligibility was perceptually assessed for general conversation sample using a six-point rating scale prepared for this study. In the rating scale, 1 represents completely intelligible, 2- minimally unintelligible, 3 - mildly unintelligible, 4 - moderately unintelligible, 5 - severely unintelligible, and 6- extremely unintelligible. A global measure of dysarthria severity representing overall level of dysarthria was perceptually rated by an SLP on a three-point scale of mild, moderate and severe impairment. Participants were classified into different dysarthria types based on the Mayo clinic system [10] into unilateral upper motor neuron (UUMN), spastic, flaccid, ataxic, hypokinetic, and hyperkinetic dysarthria by an experienced SLP.

RESULTS

The results of the study are discussed under the following headings; (a) speech characteristics of dysarthria, (b) global severity and speech intelligibility of dysarthria, and, (b) factors contributing to speech intelligibility and global severity of dysarthria.

(a) Speech characteristics of dysarthria

Among individuals with dysarthria following first ever stroke, difficulty in at least one or more than one speech

subsystem like respiration, phonation, articulation, resonation, prosody was present among participants of the study. Table 1 show the number of people in whom speech sub-systems were affected the speech characteristics observed. Speech characteristics displayed by individuals with dysarthria following stroke were; (a) labored and shallow breathing, reduced breath support for speech in respiratory sub-system (b) monopitch, monoloudness, reduced loudness, hoarse, harsh, breathy and strained voice quality in phonatory (c) Imprecise articulation and slow DDK in articulatory (d) hypernasality in resonatory and (e) slow speech rate, monotony, and reduced stress in prosodic system. It can be noted that among the speech characteristics of dysarthria, imprecise articulation was commonest followed by slow speaking rate, hoarse voice, monopitch and monoloudness.

Classification of dysarthria(s) based on the pioneer Mayo clinic classification system revealed that the occurrence of UUMN dysarthria highest (50%), followed by spastic (31.1%), ataxic (12.5%) and hypokinetic (6.2%). Characteristic of dysarthria shown by its different types were also analyzed in this study. Speech characteristics of UUMN type included labored breathing, imprecise phonemes, hoarse voice, breathy voice, low loudness, slow rate, short phrases, monopitch and monoloudness. Resonance was however mostly unaffected. Shallow and labored breathing, imprecise phonemes, harsh and strained voice quality were commonly seen features of spastic dysarthria, but, breathy and hoarse quality, slow speech rate, monotone, and prosodic impairments like excess stress were also noted. Only 2 out of 6 individuals with ataxic type had irregular articulatory breakdown and scanning speech and rest of them had speech features similar to UUMN dysarthria. One of three individuals having hypokinetic dysarthria showed classical speech characteristics imprecise phonemes, short phrases, perceived fast speech rate, frequent and inappropriate pauses. But the remaining two individuals having basal ganglia lesion showed features similar to UUMN dysarthria type.

Table 1 Frequency of occurrence and percentage of commonly observed speech characteristics in individuals with dysarthria following first ever stroke

Speech subsystem affected	N	(%)	Speech characteristics	N	%
Respiration	20	41.7	Labored	14	29.2
			Shallow	16	33.3
			Reduced breath support for speech	14	29.2
Phonation	41	85.4	Monopitch and monoloudness	21	43.8
			Low pitch	6	12.5
			Reduced loudness	14	29.2
			Hoarse	21	43.8
			Harsh	8	16.7
			Strained	12	25
			Breathy voice	11	22.9
Articulation	37	77.1	Imprecise articulation	35	72.9
			Irregular articulatory breakdown	3	6.3
			Slow DDK	33	68.8
Resonance	11	22.9	Hypernasality	8	16.7
Prosody	32	66.7	Slow rate of speech	31	64.6
			Monotone	20	41.7
			Excess stress	5	10.4
			Reduced stress	19	39.6

(b) Speech intelligibility and global severity of dysarthria

Perceptual assessment of global severity and speech intelligibility rated by SLP is shown in Table 2. Results of global measure of dysarthria severity revealed that maximum number of individuals presented with mild dysarthria (64.5%) followed by moderate (25%) and very few showed severe dysarthria (12.5%). Speech intelligibility was minimally affected in 16.6% individuals, mildly in 47.9%, moderately in 25%, severely in 6.2%, and extremely in 4.1% individuals with dysarthria following stroke. This shows global severity of dysarthria and speech intelligibility is usually mild but it can range between mild to severe for individuals following strokes. It was observed that severity was higher for individuals with spastic dysarthria for both the measures, that is, speech intelligibility and global severity.

Table 2 Distribution of percentage and occurrence of individuals with dysarthria following stroke across various factors, speech intelligibility and global severity

Factors	Total		Global Severity				Speech Intelligibility			
			Frequency (N)				Frequency (N)			
	N	%	Mild	Mod	Sev	Min	Mild	Mod	Sev	Extrm
Age (in years)										
≤ 40	4	8.3	1	2	1	1	0	2	0	1
>40 & <60	24	50	17	5	2	5	12	5	1	1
≥ 60	20	41.7	13	5	2	2	11	5	2	0
Gender										
Male	38	79.2	24	10	4	5	19	10	2	2
Female	10	20.8	7	2	1	3	4	2	1	0
Systemic diseases										
HTN	42	87.5	28	10	4	7	21	10	3	1
HTN, DM &/ or IHD	4	8.3	3	1	0	1	2	1	0	0
None	2	4.2	0	1	1	3	0	1	0	1
Lesion Type										
Non-hemorrhagic	34	70.8	26	7	1	6	20	7	1	0
Hemorrhagic	14	29.2	5	5	4	2	3	5	2	2
Lesion location										
Cortical	11	22.9	8	3	0	0	8	3	0	0
Sub-cortical	15	31.3	13	2	0	4	9	2	0	0
Combined	15	31.3	7	3	5	3	4	3	3	2
Cerebellar	5	10.4	2	3	0	1	1	3	0	0
Brain-stem	2	4.2	1	1	0	0	1	1	0	0
Lesion extent										
Localized	38	79.2	26	10	2	7	19	10	1	1
Widespread	10	20.8	5	2	3	1	4	2	2	1
Lesion side										
Right	10	20.8	7	3	0	2	5	3	0	0
Left	20	41.7	15	5	0	5	10	5	0	0
Bilateral	18	37.5	9	4	5	1	8	4	3	2
Dysarthria type										
UUMN	24	50	18	6	0	6	12	6	0	0
Spastic	15	31.3	8	2	5	1	7	2	3	2
Hypokinetic	3	6.3	2	1	0	0	2	1	0	0
Ataxic	6	12.5	3	3	0	1	2	3	0	0
Postural control										
Paralysis/ Weakness	39	81.3	25	11	3	7	18	11	3	0
Spasticity	4	8.3	2	0	2	0	2	0	0	2
Rigidity/ Slowness	5	10.4	4	1	0	1	3	1	0	0
Locomotion										
Walking	27	56.3	22	5	0	6	16	5	0	0
Sitting	5	10.4	2	3	0	0	2	3	0	0
Bedridden	16	33.3	7	4	5	2	5	4	3	2
Activities of daily living										
Independent	10	20.8	7	3	0	2	5	3	0	0
Needs assistance	20	41.7	20	4	1	5	15	4	1	0
Dependent	4	8.3	4	5	4	1	3	5	2	2

Total			31	12	5	8	23	12	3	2
Note: For global severity of dysarthria; mild- 'mild global severity', mod-'moderate global severity', and sev-'severe global severity'; and for speech intelligibility of dysarthria; min-'minimally unintelligible', mild-'mildly unintelligible', mod-'moderately unintelligible', sev-'severely unintelligible', and extm-'extremely unintelligible'										

(c) Factors contributing to global severity and speech intelligibility of dysarthria

Distribution of frequency of occurrence and percentage of individuals with dysarthria following stroke across various factors like age, gender, systemic diseases, lesion type, lesion location, lesion extent, lesion side, dysarthria types, postural control, locomotion, and ADL along with dysarthria global severity and speech intelligibility is tabulated (Table 2). Chi-square was applied to find association of severity of global dysarthria and speech intelligibility with age, gender, lesion type, lesion location, lesion extent, lesion side, systemic diseases, dysarthria type, postural control, locomotion and ADL. It can be observed from Table 3 that statistically significant association was obtained for global severity of dysarthria with its types ($p<0.05$), lesion type i.e., non-hemorrhagic vs. hemorrhagic stroke ($p<0.05$), lesion location ($p<0.05$), postural control ($p<0.05$), locomotion ($p<0.05$) and activities of daily living ($p<0.05$), however, no association obtained for age, gender, lesion type, extent, and side, and presence of systemic diseases. For speech intelligibility, association was noted with only lesion type ($p<0.05$), postural control ($p<0.05$), and locomotion ($p<0.05$). Results for each factor is discussed separately.

Table 3 Chi-Square values showing association of factors with global severity and speech intelligibility

Factors	Global Severity			Speech Intelligibility		
	X^2	df	p	X^2	df	p
Age	3.203	4	>0.05	10.131	8	>0.05
Gender	0.186	2	>0.05	2.449	4	>0.05
Systemic diseases	5.368	4	>0.05	13.024	8	>0.05
Lesion type	9.712	2	<0.05*	10.768	4	<0.05*
Lesion location	17.464	8	<0.05*	22.238	16	>0.05
Lesion extent	5.193	2	>0.05	5.481	4	>0.05
Lesion side	9.463	4	>0.05	10.795	8	>0.05
Dysarthria Type	14.297	6	<0.05*	16.313	12	>0.05
Postural control	8.343	4	<0.05*	24.822	8	<0.05*
Locomotion	15.641	4	<0.05*	16.122	8	<0.05*
ADL	12.319	4	<0.05*	13.106	8	>0.05

a) **Demographic factors:** It can be observed from Table 2 that among participants of the study, occurrence of dysarthria was higher for individuals above 60 years, followed by those between 40-60 years, and very few below 40 years. More number of males showed dysarthria with higher ratings on global severity speech intelligibility when compared to females. Most individuals with stroke had presence of at least one systemic disease like HTN, DM, and/or IHD. Presence of HTN, whether in isolation or co-occurring, was seen among most participants. However, there was no significant association obtained for age, gender and systemic disease with both speech intelligibility and global dysarthria severity on chi-square (Table 3).

b) **Etiological factors:** Among the etiological factors, the type, location, extent and side of lesion were studied in persons having dysarthria following stroke. It was observed that the number of individuals having dysarthria due to non-hemorrhagic stroke was higher compared to hemorrhagic stroke. Higher ratings were obtained for individuals with hemorrhagic stroke on global severity and speech intelligibility than for non-hemorrhagic (Table 2). Presence of multiple lesion sites was common compared to isolated lesions leading to dysarthria. Further it was observed that the lesions located at multiple sites were frequent when occurred in cortical, sub-cortical, and/or brainstem and among isolated lesions, sub cortical site was frequent than isolated cortical, brainstem or cerebellar. Individuals having multiple lesion location obtained moderate to severe ratings on global severity and speech intelligibility compared to isolated lesions. It was noted that 41.7% participants

had left hemispheric lesions, 20.85% had right sided and 37.5% had bilateral lesions leading to dysarthria. More number of individuals had dysarthria when the lesion was in left than in right hemisphere among the participants of present study. While analyzing effect of lesion side on severity of dysarthria, it was noted that in left sided lesion speech intelligibility and global dysarthria severity was higher compared to right. Moreover, lesions were localized in 79.2% of individuals but widespread in 20%. Chi-square analysis revealed a statistically significant association of lesion type with speech intelligibility and global dysarthria severity. Though, association of lesion location was seen only with global severity but not with speech intelligibility. This indicates that both measures, global severity and speech intelligibility, varies with stroke type and that dysarthria is usually severe among individuals with hemorrhagic stroke. However, no significant association was obtained for lesion site, lesion extent, with global severity and speech intelligibility ratings.

c) **Type of Dysarthria:** Occurrence of UUMN dysarthria was highest (50%), followed by spastic (31.1%), ataxic (12.5%) and hypokinetic (6.2%). Both measures of dysarthria severity, that is speech intelligibility and global severity varied with different dysarthria types. More number of individuals with spastic dysarthria had high global severity but for a majority of persons with UUMN had mild degree (Table 2). Similarly, speech intelligibility was mildly affected in individuals with UUMN type contrary to severely affected speech intelligibility among spastic type. However, statistically significant association of dysarthria types was obtained with global severity but not with speech intelligibility.

d) **Locomotion, Postural control and ADL:** Among the general characteristics of dysarthria, Physical condition, postural control, locomotion and ADL were investigated in this study. Physical condition was impaired in 79.2% (38) with dysarthria following first ever stroke. Many individuals had impaired postural control and like paralysis/weakness of limbs (81%), followed by rigidity or slowness of movements (10%) and spasticity (8%). Among individuals who had some locomotory issues, 33% could not move and were bedridden, 10% could sit with support and locomoted through wheelchair and 56% needed support for walking. Impaired postural control was observed in 53% (26) of individuals however 47% (23) had no postural abnormality. On Chi-square, statistically significant association was obtained for postural control, locomotion and ADL with global severity; however, for with speech intelligibility association was noted for postural control and locomotion but not for ADL. It was also noted that many individuals needed assistance while performing activities of daily living, few where completely dependent and some could manage independently. Feeding issues were also observed in 47% (23) of individuals with dysarthria following stroke.

DISCUSSION

In the present study, individuals with dysarthria following first ever stroke displayed some common speech characteristics like imprecise articulation, hoarse voice quality, slow speech rate, monotony and labored breathing, reduced breath support for speech. Imprecise phonemes, commonly known as slurred speech, slow speech rate, hoarseness and monopitch were among the frequently observed speech characteristics shown by individuals with dysarthria following stroke. Earlier researchers studying dysarthria in patients with stroke have also reported imprecise articulation, harsh and strained voice, reduced rate, and reduced inflections as commonly seen features of dysarthria [17,18,15,20] as observed in this study. However, there were few exceptions in terms of classical speech characteristics displayed by different dysarthria types in this study. Irregular articulatory breakdown and scanning speech was not displayed by four out of seven individuals having cerebellar lesion and, two out of three basal ganglia lesion showed speech characteristics similar to UUMN type and displayed no classical feature of hypokinetic or hyperkinetic type. Mackenzie [20] in his review reported similar findings, as observed in present study, in his participants with differing lesion locations but same etiology, that is stroke, showed similarities in speech characteristics. Imprecision of articulation, reduction in speaking rate, monotony of speech and harshness were commonly present features in his participants with in stroke regardless of lesion site.

In this study, most individuals having dysarthria due to first ever stroke had unilateral upper motor neuron (UUMN) dysarthria followed by spastic type frequently having mild severity both for speech intelligibility and global severity. Both the types are known to be associated with pyramidal tract damage thereby frequently producing pyramidal tract signs among 80% of participants. However, very few other dysarthria types, like ataxic and hypokinetic were found. This finding is supported by a study which reports that vascular lesions usually results into UUMN and spastic

dysarthria mostly having mild severity. Urban, et. al. [14] in a study reported that their all 68 patients with dysarthria having extra cerebellar infarcts were located along the course of pyramidal tract thereby occurrence of associated pyramidal tract signs were present in 90.7% (n=62) of patients. Hence, findings of the present study add support to the literature that vascular lesions particularly strokes commonly lead to UUMN and spastic dysarthria(s).

Maximum number of individuals with stroke obtained mild degree on both measures that is global severity of dysarthria and speech intelligibility; however, there were some individuals with other degrees as well. Individuals presenting with milder severity were mostly UMMN type and those with severe degrees were spastic type. Similar findings are reported by Duffy [19] showing higher number of UUMN dysarthria in individuals with stroke. Present study also shows an interesting finding that frequency of left hemispheric lesions leading to dysarthria was higher than right sided lesions. In addition, overall severity of dysarthria was found to be higher for left sided lesions. Similar findings have been reported by earlier researchers stating that dysarthria is observed commonly in left hemispheric lesion compared to right supratentorial strokes, indicating that descending pathway from the left motor cortex is more dominant [14,15] and its severity was higher in left sided strokes compared to right irrespective the site of lesion [14].

The study also investigated association of global severity and speech intelligibility with several factors such as age, gender, systemic diseases, lesion type, lesion location, lesion extent, lesion side, dysarthria types, postural control, locomotion, and ADL contributing to. Dysarthria was frequently seen in males than females and its occurrence was highest in individuals above 60 years followed by individuals between 40 to 60 years but very low among individuals below 40. HTN was frequently observed to be present as one of the systemic diseases among individuals with stroke leading to dysarthria, although, DM and IHD were associated with it. Present findings are supporting earlier studies reporting that risk of stroke is higher and increases by 12% in individuals above 40 years [2] thereby increasing the presence of communication disorders among them. However, there was no direct association of age, gender and systemic diseases with dysarthria global severity and speech intelligibility.

Lesion type that is ischemic vs. hemorrhagic stroke was found to be directly related to dysarthria severity. Ischemic stroke was frequent compared to hemorrhagic among participants of the study but severity of global measure of dysarthria and speech intelligibility was higher among individuals with hemorrhagic stroke. This shows a relationship between type of stroke and dysarthria severity indicating that dysarthria is usually severe among individuals with hemorrhagic stroke. Further while analyzing lesion location, co-occurring lesions at multiple sites were common than isolated ones. Co-occurrence of cortical with sub-cortical lesions was frequent among lesions at multiple locations and among isolated lesions, occurrence of subcortical site was frequent than others. There were very few isolated brainstem and cerebellar lesions also. Moreover, cortical involvement was present in most individuals having dysarthria following first ever stroke. Though, global severity of dysarthria and speech intelligibility was higher in individuals having lesions at multiple sites compared to isolated ones. However, no association of lesion location could be obtained with global severity and speech intelligibility. Among the other aetiological factors such as of lesion side and extent, no association was obtained with dysarthria global severity and speech intelligibility, however, dysarthria was frequent and severe when the lesion was in left hemisphere than right. This finding is supported by studies reporting presence of dysarthria commonly observed in left hemispheric lesion compared to right supratentorial strokes, indicating that descending pathway from the left motor cortex is more dominant [15,14], also, severity of dysarthria was higher in left sided strokes compared to right irrespective the site of lesion [14].

Unlike the aetiological factors, type of dysarthria was associated with global severity but not with speech intelligibility indicating that global severity varies with types of dysarthria. But for both measures, severity was higher among spastic dysarthria compared to other types. It was also observed that postural control, locomotion and ADL were associated with global severity and with speech intelligibility except ADL. This indicates that global severity of dysarthria, as its name suggests, contributes to overall severity of dysarthria including physical characteristics. Most individuals with dysarthria had some physical impairment with involvement of limb paralysis, weakness, in-coordination, or postural abnormality. A high percent of individuals was completely dependent or needed assistance in activities of daily living. Almost half of individuals with dysarthria had co-occurring swallowing disorder, a finding commonly reported among individuals with stroke [16].

CONCLUSION

In summary, the results of the study indicate that there are some speech characteristics like imprecise articulation, slow speaking rate, hoarse voice, monopitch and monoloudness are commonly seen in individuals with dysarthria irrespective of its type. UUMN dysarthria was most frequently present in individuals with stroke followed by spastic type. Severity of dysarthria, measured by speech intelligibility and global severity, was usually of mild severity in most participants although higher severities were also noted. Severity was high for spastic dysarthria for both speech intelligibility and global severity. Speech intelligibility and global severity showed significant association with lesion type, dysarthria type, and general physical characteristics.

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